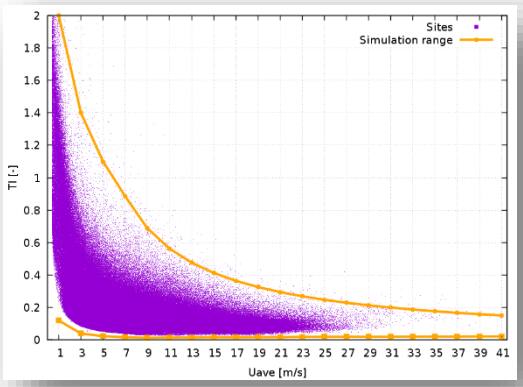
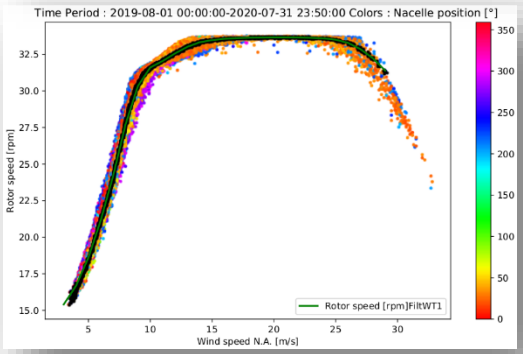
Wind Turbine Lifetime Estimation

Wind turbines are normally designed for 20 years lifetime. This is usually also the contractual operational period for a wind farm, depending on the local energy policy framework. However, the actual conditions under which the turbines operate, are possibly milder than those that they were designed for, thus allowing for an extended service life of the turbines beyond their design lifetime, which can be appreciated through theoretical analysis.

In this scope, iWind has developed a Lifetime Estimation procedure based on the theoretical part of DNV-GL "*Lifetime Extension of Wind Turbines*" Standard, conducted by means of calculations for the wind turbines, considering their site-specific external conditions. The procedure comprises the following steps:

- Study of the WT inflow conditions through CFD micro-siting and/or SCADA data analysis.
- Build of a WT generic aero-elastic model based on relevant information provided by the Client (e.g. SCADA data) and openly available (e.g. brochures, general specifications). Definition of "load sensors" along the WT's components.
- Deployment of fatigue loads database from aero-elastic calculations addressing *IEC-61400* fatigue limit state DLCs with IEC and also site-specific conditions.
- Interpolation of the full set of site-specific conditions in the loads database, using Neural Networks.
- Fatigue damage calculations per turbine and "load sensor", estimation of expected lifetime through comparisons against IEC damage calculations.
- Lifetime Estimation results presented as P_{50} (expected values) and other percentiles deriving from the uncertainty analysis, regarding the inflow conditions and the generic model.





Based on the results, iWind will suggest a service life extension scheme for the wind turbines, that can significantly increase the efficiency of the investment. This service is addressed to:

- Wind farm developers and operators seeking to maximize their investment output.
- Financial houses seeking due diligence investigation of an existing or developing wind farm project.

Component		P_{50}	P_{75}	P_{90}
Cat.1	Tower	36.6	32.2	29.1
	Nacelle Welded	>40.0	>40.0	>40.0
	Nacelle Cast	>40.0	>40.0	>40.0
	Hub	29.1	26.3	24.3
Cat.2	Blade Flap	>40.0	>40.0	>40.0
	Blade Edge	32.5	26.7	23.1
Cat.3	Pitch mechanism	>40.0	>40.0	>40.0
	Blade/Hub interface	27.6	25.5	23.9
	Hub/Shaft interface	>40.0	>40.0	>40.0
	Yaw mechanism	>40.0	>40.0	>40.0
	Nacelle/Tower interface	>40.0	>40.0	>40.0